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ABSTRACT

Part of a series of curriculum guides dealing with industrial education in junior high schools, this guide provides a course on drafting to be used in the ninth grade. Thirteen goals are identified for the students to demonstrate: (1) a knowledge of the relationship between drafting and the work of designers, engineers, and architects; (2) an understanding of the importance of lettering; (3) the ability to letter legibly; (4) a knowledge of the proper use and care of drafting equipment; (5) the use of proper drafting techniques; (6) an understanding of the importance of geometric concepts; (7) a comprehension of orthographic projection; (8) the skill of proper dimensioning; (9) an understanding of sectioning; (10) a familiarity with auxiliary views; (11) a knowledge of the concepts involved in development drawings; (12) an understanding of pictorial drawings; and (13) a recognition of the career opportunities available in drafting related occupations. Besides the traditional teaching method, two other alternative approaches are suggested for the teacher: developing drafting unipacs so that students can have more individualized instruction and team teaching so that the drafting course can be more closely related to the woods and metals course. A chart is included to predict the effectiveness of each alternative in achieving the goals and to compare the resources and expenses required for each. (ELG)

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INDUSTRIAL EDUCATION

DRAFTING - 9th Grade

Program Description

Drafting is an elective course offered to all ninth grade boys and girls at each of the six junior high schools. Approximately 400 students are annually enrolled in the course with an average of 28 students per class. Classes meet fifty minutes daily, five days a week for one semester. Each student receives ½ credit towards high school graduation.

Drafting at the ninth grade level is exploratory in nature. In drafting, the students will become acquainted with the various careers and the skills and knowledge needed by a draftsman.

Goals

1. The students will understand the relationship between drafting and the work of designers, engineers, architects, and other workiers in industry.

   Objective 1 - The students will be able to define all of the terms which identify drafting as a communicative skill.

   Objective 2 - Given a list of career occupations, the students will be able to discriminate those areas of industry which have a direct relationship with drafting.

   Objective 3 - Given a list of work habits and traits, the students will be able to choose those work habits and traits which are required to be a successful draftsman.

2. The students will develop an understanding of the importance of lettering.

   Objective 1 - Given examples of student work in lettering, the students will be able to discriminate acceptable lettering versus unacceptable lettering.

   Objective 2 - The students will indicate an appreciation of good lettering by practicing lettering on their own outside of class.

3. The students will develop the ability to letter legibly.

   Objective 1 - The students will construct vertical, capital, single-stroke, freehand, gothic lettering to a degree of neatness and accuracy specified by the teacher's examples.

   Objective 2 - Given a set of lettering exercises, the students will construct words and sentences using correct spacing and composition to a degree of accuracy and neatness specified by the teacher's examples.

Objective 3 - Given a lettering device such as a Zephur or LeRoy lettering machine, the students will demonstrate their ability to correctly operate such a device.

4. The students will demonstrate a knowledge of the proper use and care of basic drafting equipment.

Objective 1 - Given a set of basic drafting equipment which include boards, pencils T-square, triangles, irregular curves, compass, and protractor, the students will maintain care and cleanliness of the equipment as specified by the established drafting code.

Objective 2 - Given a set of basic drafting equipment which includes pencils, board, T-square, triangles, curves, compass, and protractor, all of the students will correctly use the equipment to draw lines, curves and circles as specified by the drafting code.

Objective 3 - Given a drafting scale (divisions of 1/16"), the students will correctly measure and draw lenghts to an accuracy of $\pm$ 1/64".

Objective 4 - Given a drafting scale, the students will correctly draw and measure lines to scale (reduced proportion).

5. The students will use proper drafting techniques in the development of drawings.

Objective 1 - The students will be able to recognize the various line symbols as specified by the "alphabet of lines".

Objective 2 - Given a drawing assignment, the students will construct borders and titlestrips and fill-in the titlestrip with the appropriate information.

Objective 3 - The students will be able to construct the various line symbols as specified by the "alphabet of lines".

Objective 4 - Given a drawing assignment, the students will layout the problem so that it is centered and then completed in the specified order of penciling.

Objective 5 - Given a drafting evaluation form, the students will rate their performance to help assess areas of strengths and weaknesses.

6. The students will understand the importance of applying and constructing geometric concepts used in drafting.

Objective 1 - Given objects containing basic geometric shapes, the students will be able to identify those geometric shapes.

Objective 2 - Using a straightedge, compass, and pencil, the students will be able to construct specified geometric constructions to a degree of neatness and accuracy as specified by the teacher's examples.

7. The students will understand the principles of orthographic projection.

   Objective 1 - The students will be able to explain the theory of planes of projection as it applies to shape description.

   Objective 2 - Given an object or picture of an object, the students will choose those views which best describe the object.

   Objective 3 - Applying the theory of orthographic projection, the students will draw the representation of an object to a degree of neatness and accuracy specified by drafting standards.

8. The students will demonstrate proper dimensioning.

   Objective 1 - The students will be able to list the purposes of dimensioning.

   Objective 2 - Given a drawing to be dimensioned, the students will locate and draw all necessary dimensions according to preferred practices.

   Objective 3 - Given a drawing to be dimensioned, the students will identify all necessary dimensions of the drawing.

9. The students will demonstrate an understanding of the concepts of sectioning.

   Objective 1 - The students will be able to explain the nature and purpose of sectional views.

   Objective 2 - Given an object to be sectioned, the students will choose the appropriate section and locate the cutting plane line which best describes the hidden interior of the object.

   Objective 3 - Given an object to be sectioned, the students will draw a sectional view which includes all necessary and appropriate lines.

10. The students will demonstrate an understanding of the concepts of auxiliary views.

    Objective 1 - The students will be able to explain the nature and purpose of auxiliary views.

    Objective 2 - Given an object requiring an auxiliary view, the students will locate the auxiliary plane of projection which will best describe the object

Objective 3 - Given an object requiring an auxiliary view, the students will draw the auxiliary view in its correct relationship with the other views.

11. The students will demonstrate an understanding of the concepts of development drawings.

Objective 1 - The students will explain the nature and purpose of development drawings.

Objective 2 - Given a simple plane surface object, the students will develop the pattern for it.

Objective 3 - Given a simple curved surface object, the students will develop the pattern for it.

Objective 4 - The students will identify the need for developed objects in the world by bringing to class examples or picture of examples of developed objects on a voluntary basis.

12. The students will gain an understanding of pictorial drawings.

Objective 1 - The students will define the need for pictorial drawings as a part of the graphic language.

Objective 2 - The students will identify the various kinds of pictorial drawings, ie. isometric, oblique, cabinet, and perspective.

Objective 3 - The students will draw a simple object by using three of the four pictorial methods.

13. The students will recognize the various career opportunities available to them in drafting related fields.

Objective 1 - The students will interact through discussion with a guest speaker on the topic of career exploration in drafting.

Objective 2 - Given a career survey form the students will interview parents, friends, and neighbors to determine the various roles drafting plays in their vocations.

Objective 3 - The students will participate in a project or field trip to explore career opportunities in drafting.

Suggested Course Outline

The following course outline is offered to serve as a suggested guide in dividing the eighteen week semester into alloted times for the basic drawing principles.

AREA	TIME IN WEEKS
Lettering	1
Use of Equipment (templates)	1
Geometric Construction (templates	2
Orthographic Projection Dimensions	4
Sections	3
Auxiliaries	3
Developments	2
Pictorials	2
	18 Weeks

The above outline can and should be altered in either sequence or alloted time in order to meet the assessed needs of classes and individual students.

Program Alternatives

Alternative 1 - The Present Program

The present program is basically traditional in nature. The various areas of drafting are introduced to the students through class lecture and demonstrations whereupon the students are assigned a set of drawings to be completed in the specified area.

The instruction is somewhat individualized since assigned drawings are progressively more difficult and each student progresses from one drawing to the next at his own rate allowing students along the total range of capabilities to work at their own potential. Further, the teacher is free to give individual help to those students where needed.

In order to implement Alternative 1, the following considerations would have to be made:

1. Provide an in-service training program that will aid the teacher in obtaining the goals and objectives of the course.
2. Adequate space and equipment should be provided in each laboratory.
3. An appropriate text or suitable course of study should be provided for the course.

4. Adequate materials are needed and a flexible method of ordering should be provided.
5. Adequate audio visual aids are needed with ease of accessibility and facilities to use them.
6. Adequate reference books and materials pertaining to the course with ease of accessibility.
7. A brochure describing the course to orient counselors, principals, and other administrators.
8. Maximum class size should be in agreement with state recommendations or adjusted in accordance to the size of the laboratories.

Alternative 1 - The Present Program - Program Constraints

1. Complete individualization is not fully achieved since time periods in each area of drafting are not totaly flexible.
2. Students sometimes have difficulty relating what they draw and what is drawn in industry.
3. Students at times lose interest due to the lock-step structure of the course.
4. Labs and equipment are not consistant in all junior high schools.
5. Labs are not properly equipped for use of audio visual aids.
6. Ordering supplies and equipment nine months in advance often results in inadequate materials to meet increased enrollment.

Alternative 2 - Drafting Uni-Pacs

The use of drafting uni-pacs as a method of instruction would provide for more individualized instruction. The uni-pacs would be developed for each area of drafting and presented to each student in proper sequence.

Each uni-pac would contain a pre-test, examples of drafting concepts, drafting problems to test their understanding of the concepts, and post-test. The pre-test would be used to determine at which point the student would begin the drafting porblems. The students would then progress through the uni-pac at their own rate until they completed the uni-pac or until they reached a level of competency determined by the instructor and/or final test indicating an understanding of that particular area.

For those students who are considered to progress too rapidly through the uni-pac, the extra time available to them could be used in two ways. They could be assigned enrichment drawings requiring greater skill and knowledge or they could be used as class foremen. As class foremen,they would be teacher aides giving assistance to those students who are slower.

The teacher would no longer lecture to the class as a whole; instead, he

would instruct small groups of one or more students as they advance from one uni-pac to the next. The teacher's daily routine would also include giving individual help to those students requiring it along with assistance from class foremen.

In order to implement Alternative 2, the following considerations would have to be made:

1. Same as Alternative 1, implementations (2, 4, 5, 6, 7, 8).
2. Administrative approval for the curriculum change is required.
3. Summer writing team is needed to restructure the curriculum to incorporate uni-pacs.
4. Need to print and distribute uni-pacs.
5. Provide in-service work shop to acquaint the instructors with concepts of uni-pac instruction.

Alternative 2 - Drafting Uni-Pacs - Program Constraints

1. Same as Alternative 1, constraints (2, 4, 5, 6).
2. A need to overcome teacher attitude with regard to curriculum change.
3. Large volume of printed and collated materials is required.
4. Staff difficulty to adjust to the change from the traditional to the individualized form of instruction.
5. Some students cannot adjust to a self-motivating individualized approach from a teacher centered traditional approach.

Alternative 3 - Team Teaching

In an effort to more closely relate Drafting 9 with the other ninth grade elective, Industrial Education 9, Woods and/or Metals, the two courses would be combined. The result would provide an atmosphere closely related to actual industrial practices. The students would become involved with the relationship between drafting and industrial processes. This alternative would provide two credits towards graduation by combining the course for two consecutive periods.

The course would be structured to permit students to graphically develop a product in the drawing lab as is done in product designing in industry and then they would manufacture the product in the processing lab. Both instructors would serve as resource persons in their specialized areas, but at the same time, combine their efforts to more closely relate their two areas to each other.

In order to implement Alternative 3, the following considerations would have to be made:

1. Same as Alternative 1, implementations (1, 2, 3, 4, 5, 6, 7, 8).
2. Administrative approval for the curriculum change is required.
3. Two consecutive class periods are needed.
4. Change staff attitudes.
5. Adjoining labs or convenient passage between two labs.
6. Summer writing team to formulate curriculum change is needed.
7. Select two compatable teachers.

Alternative 3 - Team Teaching - Program Constraints

1. Same as Alternative 1, constraints (4, 5, 6).
2. Difficulty in scheduling two consecutive periods will occur.
3. All aspects of drafting and/or process skills may not be sufficiently explored.
4. There must be curriculum agreement between Graphic Communications and Industrial Education 9 - Woods and/or Metals.

Predicted Effectiveness

In predicting the effectiveness of the objectives of Drafting 9, the considerations would include the nature of the measurement instruments and the level of acceptable performance by the students. Measurement instruments include (1) teacher evaluation of students' graphic performance and work habits, (2) use of teacher designed tests, (3) teacher evaluation of students' behavior in willingness to explore the areas of drafting, and (4) students' self-evaluation of his own work.

** Predicted effectiveness Percentage Chart on next page.

** PREDICTED EFFECTIVENESS PERCENTAGE CHART

GOAL	OBJECTIVE	ALT. 1	ALT. 2	ALT. 3
1	1	75%	75%	75%
	2	75%	75%	85%
	3	90%	90%	70%
2	1	100%	100%	100%
	2	40%	50%	30%
3	1	75%	75%	75%
	2	75%	75%	75%
	3	25%	40%	25%
4	1	90%	95%	95%
	2	90%	90%	90%
	3	95%	95%	95%
	4	85%	85%	80%
5	1	90% at 70% +	95% at 80% +	90% at 70% +
	2	80% at 70% +	85% at 70% +	80% at 70% +
	3	100%	100%	100%
	4	90%	90%	90%
	5	100%	100%	100%
6	1	80%	85%	80%
	2	75% at 70% +	85% at 70% +	70% at 70% +
7	1	80% at 70% +	80% at 70% +	80% at 70% +
	2	95%	95%	95%
	3	80% at 70% +	85% at 70% +	80% at 70% +
8	1	90% at 75% +	95% at 75% +	90% at 75% +
	2	80%	80%	80%
	3	90% at 75% +	95% at 75% +	90% a+ 75% +
9	1	90% at 75% +	90% at 80% +	80% at 70% +
	2	80% at 75% +	85% at 75% +	75% at 75% +
	3	80% at 75% +	85% at 75% +	75% at 75% +
10	1	85% at 75% +	90% at 75% +	70% at 75% +
	2	80% at 75% +	85% at 75% +	60% at 75% +
	3	80% at 75% +	85% at 75% +	60% at. 75% +
11	1	75% at 75% +	75% at 75% +	90% at 75% +
	2	70% at 75% +	70% at 75% +	90% at 75% +
	3	65% at 75% +	65% at 75% +	80% at 75% +
	4	40%	40%	60%
12	1	80% at 75% +	80% at 75% +	70% at 75% +
	2	90%	90%	80%
	3	80% at 75% +	85% at 75% +	70% at 75% +
13	1	50%	50%	50%
	2	100%	100%	100%
	3	100%	100%	100%

Program Evaluation

In evaluating any of the alternatives as effective in presenting the program, many evaluative measures should be used. The first determination to be made is whether the program objectives have been met through the existing measuring devices. A follow-up method of measuring the objectives would be a power test in drawing problem structure given to the students at the end of the school year in a non-threatening form. The above information could then be best reviewed and evaluated in an in-service meeting at the end of the school year. Finally, long-range effectiveness could be measured by determining how many students continue to explore drafting by electing more advanced courses in drafting at the high school

Resource Requirements and Estimated Costs

DESCRIPTION	ALT. 1	ALT. 2	ALT. 3
1. Classroom Teachers @ $10,800/yr.	(5) 54,000	(5) 54,000	(10) 108,000
2. Classroom Teachers for Curriculum Revision @ $936/es.	- 0 -	(,280	(6) 5,616
3. Classroom Teachers In-Service Workshop @ $26/day	130 (1 day x 5)	390 (3 days x 5)	780 (3 days x 10)
4. Teacher Subs. to cover Field Trips @ $26/day	2 trips 1 sub. 260	2 trips 1 sub. 260	trips 1 sub. 260
5. Curriculum Revision, Printing, Collating, Distribution	- 0 -	150 Uni-Pac sets @ $10 each 1500	500
6. Consumable Materials	Student Fees - 0 -	Student Fees - 0 -	Student Fees - 0 -
7. Equipment	- 0 -	- 0 -	- 0 -
8. Instructional Supplies	- 0 -	Uni-Pac Material 700	- 0 -
9. Field Trips, Buses @ 75¢/mi.	89	89	89
Total	$54,479	$61,619	$115.235*

*NOTE 1: Estimated costs would be shared by the Industrial Education 9, Woods and/or Metals.

*NOTE 2: Estimated costs does not include expenditure on lab equipment, estimated at $20,000 per lab.